Space Weather Technical Forecast

Issued on Tuesday, 16 November 2021 at 12:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor Geomagnetic Storms likely on day 1 (16th). Chance of Active Electron Fluence day 2 (17th) onward

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was very low with three benign sunspots on the visible disc and no significant flare activity. AR2894 and AR2896 in the southeastern and southwestern quadrants respectively, are both classified as mature Hsx/Alpha regions. A further new region in the northeastern quadrant, also appears to be weak and classified as an Axx/Alpha. No Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds rapidly increased from 300km/s to a peak of 630km/s at 16/0225UTC during the last 24 hours, and has averaged around 600km/s, as the Earth connected with the high speed stream from coronal hole 19. This increase was preceded by a CIR (co-rotating interaction region) where the density increased to a peak of 65ppcc at 15/2004UTC, before returning to around average values. During the onset of the high speed stream, the IMF increased to a peak of 23nT at 15/2017UTC before declining to mainly moderate levels. The north-south component, Bz varied between positive and negative values with peaks of +19 nT at 15/2017 UTC and -17 nT at 15/1937 UTC. The phi angle was initially mainly positive (away from the Sun), but after a period of variance during the CIR became mainly positive from around 16/0225UTC. Geomagnetic activity was Quiet, but was Active between 15/1800 and 16/0600UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at background levels. The high energy electron flux (greater than 2 MeV) reached high levels between 14/1405-1715 UTC, peaking at 2750pfu at 15/1535 UTC and again 15/1605 UTC, before dropping to background 15/2100 UTC onward. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), on a steady trend, with 3.73e7 integrated pfu recorded at 16/0000 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be mainly very low, with a slight chance of C-class flares from the three sunspot regions.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Solar wind speeds are expected to remain elevated or strong through days 1 and much of day 2 (16th and 17th November) then declining through days 3 and 4. Geomagnetic Activity is expected to be Unsettled to Active with a likelihood of G1/Minor Storm at first, easing to Unsettled to Active, with a decreasing chance of G1 Minor storm intervals by day 2 (17th). Activity then easing to be Quiet to Unsettled day 3 (18th) onward.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at background levels. The high energy electron flux (greater than 2 MeV) is expected to rise in response to recent solar wind enhancement, as the winds ease from later on day 2 (17 November), becoming persistently high for the remainder of the period. The corresponding 24-hour electron fluence is expected to rise in response on day 1 (16th), likely increasing above the Active (1e8 integrated pfu) threshold day 2 (17th).

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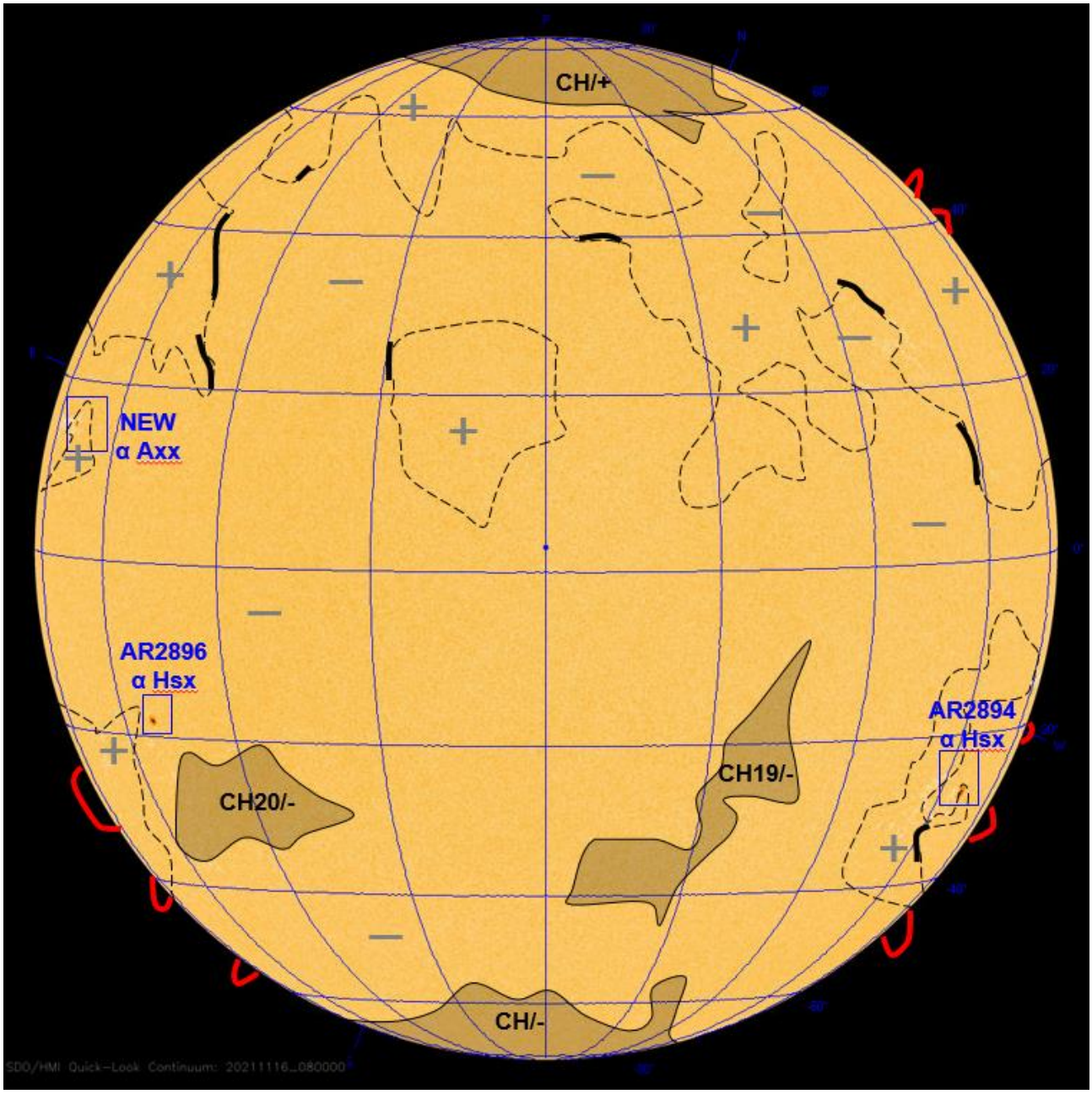
Figure 1. Solar Analysis Valid 16/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs in the forecast period.

Solar wind speeds are elevated or strong due to a connection to the high speed stream from coronal hole 19. Although the Earth is north of the solar equator with the hole to the south, the strength of the high speed stream, and preceding CIR (co-rotating interaction region) appear to have led to an earlier onset than forecast by persistence. The high speed stream is expected to continue at a similar level through the remainder of day 1 and through much of day 2 (16 and 17 November) before declining on day 3 (18 November).

Geomagnetic activity is expected to be mainly Unsettled or Active, with a likelihood of G1/Minor Storms on day 1. Unsettled periods are then expected on day 2, with a likelihood of Active intervals. Mainly Quiet to Unsettled conditions are then expected through day 3, with a decreasing chance of Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	20	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None expected

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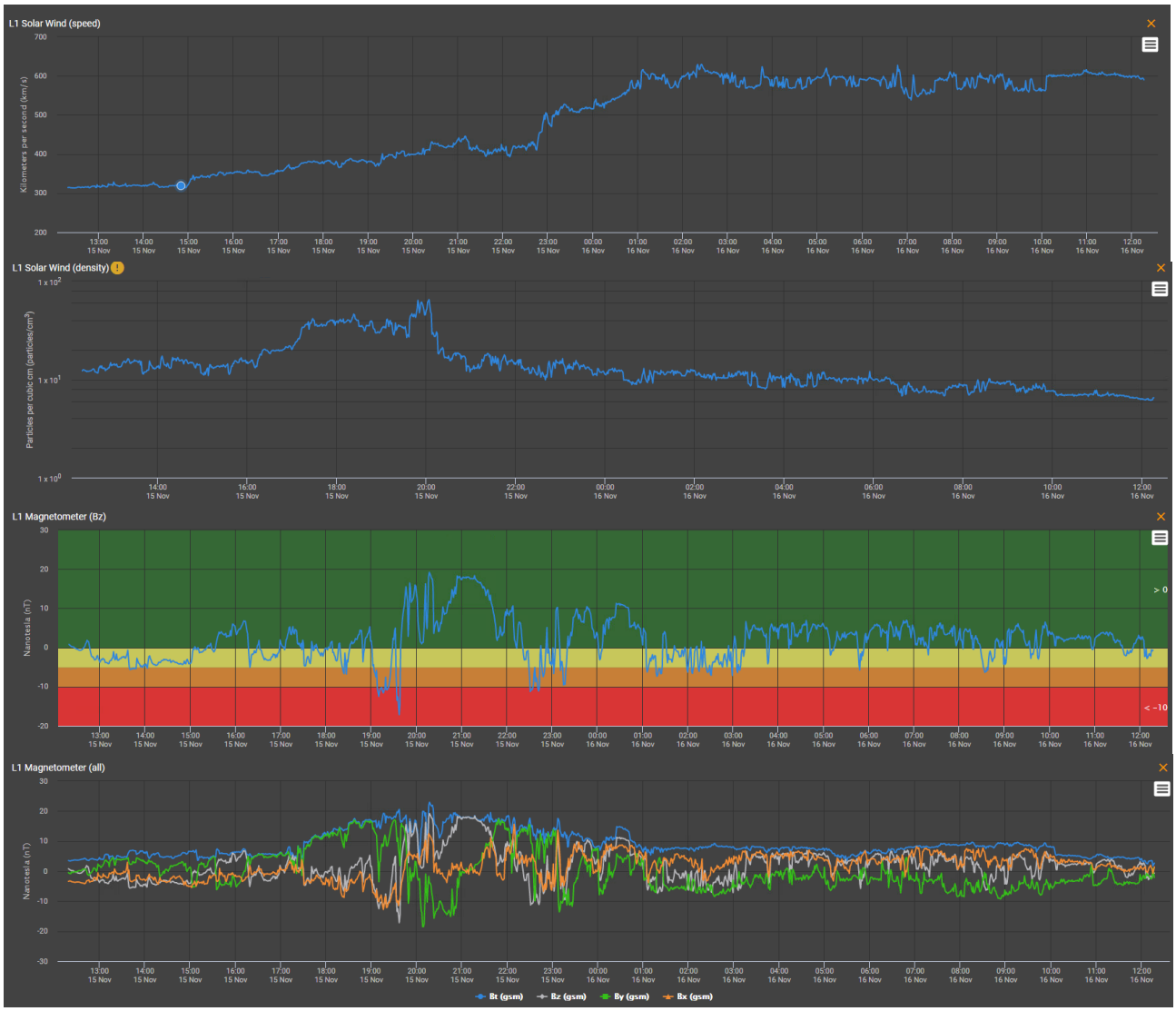
Figure 2: L1/DSCOVR solar wind parameters for the last 24 hours, with the CIR and subsequent high speed stream clearly evident.



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Radio Blackouts - X-Ray Flares:

There are three sunspot regions on the visible disc, all of which are currently benign alpha regions. AR2894 and AR2896 in the southwestern and southeastern quadrants respectively, are both mature and benign Hsx regions, with no signs of development. A new region in the northeastern quadrant is classified as an Axx region, with correspondingly low risk of flare activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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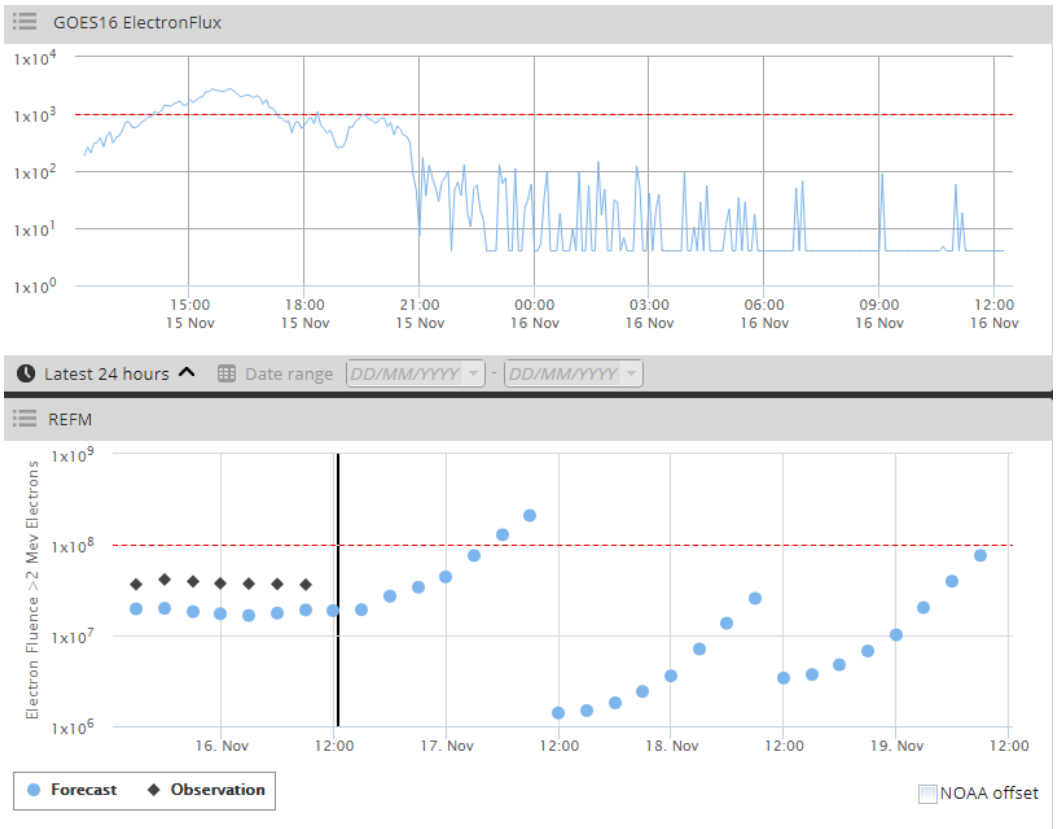
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) as measured by GOES-16 are currently at background levels, likely due to a mixture of radiation belt distortion due to the strong high speed stream, and a redistribution of electrons in the belts due to the recent geomagnetic enhancements. As a result, background levels are expected to continue through day 1 and much of day 2 (16 and 17 November), with an increase in flux coinciding with the decrease in solar wind speeds and geomagnetic activity, leading to a sustained period of high electron flux values.

Electron fluence is following a steady trend, but is then forecast to increase rapidly in line with the forecast increase in the electron flux. REFM forecasts that fluence will reach the Active (1e8 integrated pfu) on day 2, with this trend broadly accepted.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	70	70	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	5	1

Figure 3: GOES-16 electron flux and MOSWOC REFM fluence model



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